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Asai

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(54) **CONNECTOR**

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(51) **Int. Cl.**

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H01R 12/79	(2011.01)
H01R 12/70	(2011.01)
H01R 12/71	(2011.01)

(52) **U.S. Cl.**

CPC ***H01R 12/79*** (2013.01); ***H01R 12/7058*** (2013.01); *H01R 12/7082* (2013.01); *H01R 12/716* (2013.01)

(58) **Field of Classification Search**

CPC H02R 27/00; H01R 13/2442; H01R 23/7068; H01R 13/6873; H01R 23/682
USPC 439/630, 626, 607.31, 607.32
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0142909 A1 6/2005 Akasaka et al.
2010/0210130 A1 * 8/2010 Yamaji et al. 439/352

FOREIGN PATENT DOCUMENTS

JP	2005-190818	A	7/2005
JP	2008-097851	A	4/2008
JP	2011-113823	A	6/2011
JP	2012-033439	A	2/2012
JP	2012-252864	A	12/2012
JP	2013-41771	A	2/2013

OTHER PUBLICATIONS

Notice of Office Action for Japanese Patent Application No. 2013-129672, issued by the Japan Patent Office on Jan. 28, 2015.

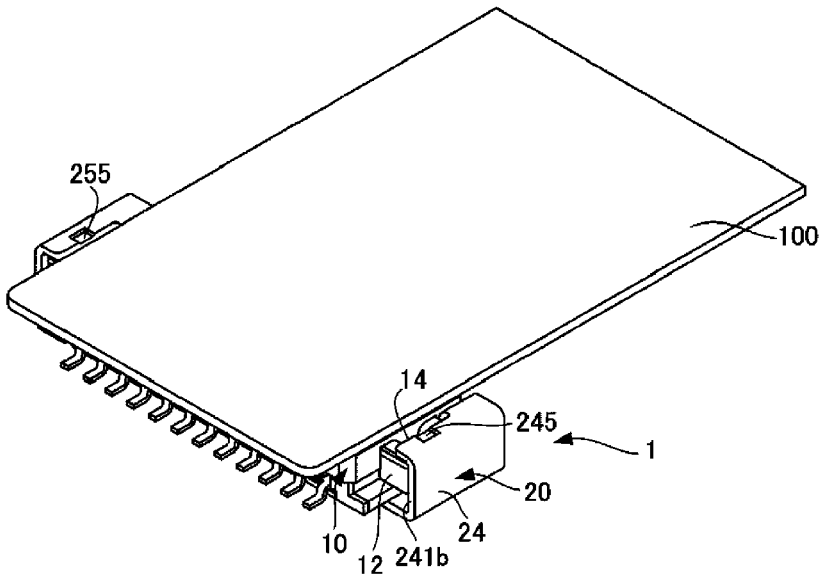
* cited by examiner

Primary Examiner — Phuong Dinh

(57) **ABSTRACT**

A connector includes a plug and a receptacle. The plug includes: contacts; a reinforcing plate formed in an elongate plate shape; and locking parts provided at positions projected from opposite side surfaces of a housing in a width direction thereof. The receptacle includes: contacts having the number and positions corresponding to those of the contacts of the plug; and hold-down parts provided at positions projected from respective side surfaces of a housing in a width direction thereof. Each of the hold-down parts has an insertion opening and an internal space into which the locking part of the plug can be inserted in a depth direction of the housing, and a holding part for holding the locking part at a predetermined position. The insertion opening is in communication with the internal space in the depth direction of the housing.

8 Claims, 11 Drawing Sheets



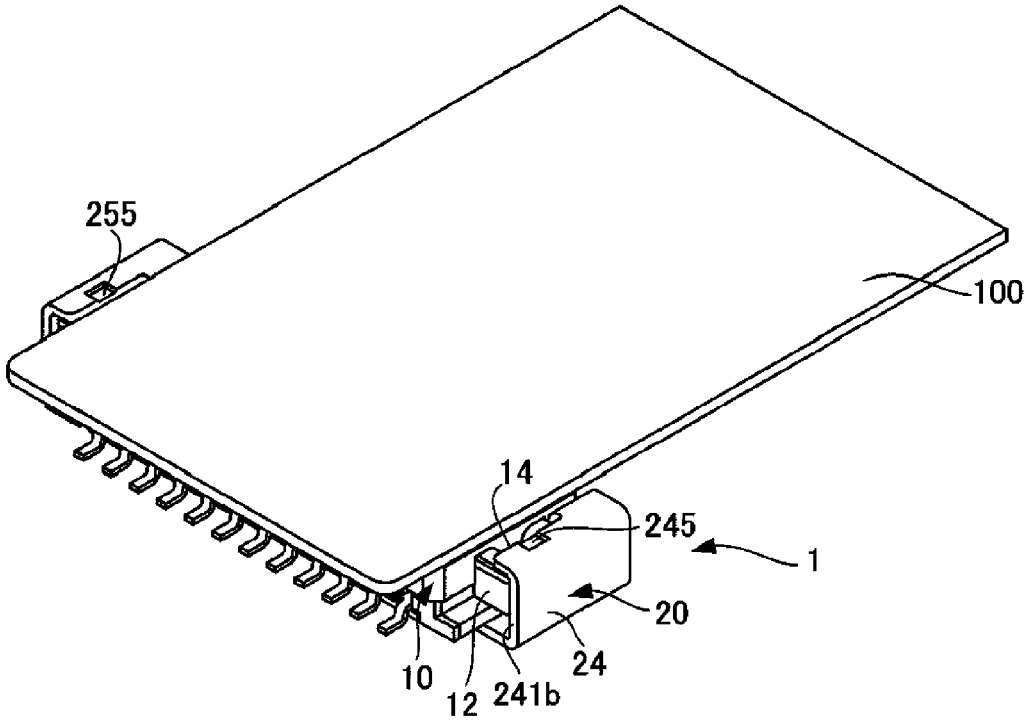


FIG. 1A

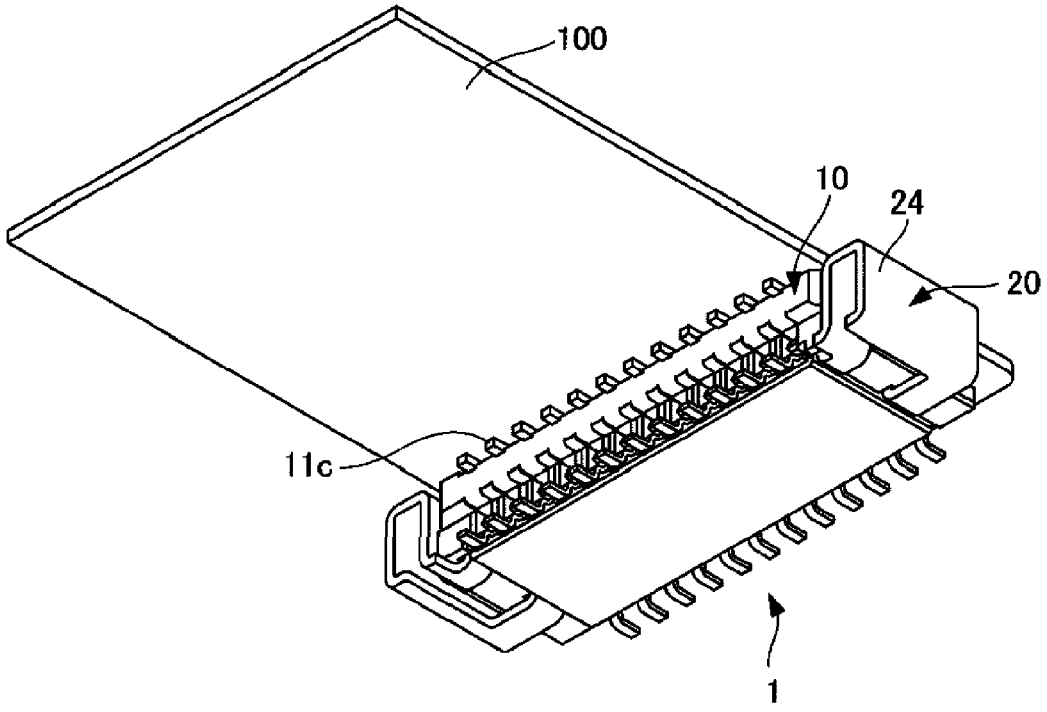


FIG. 1B

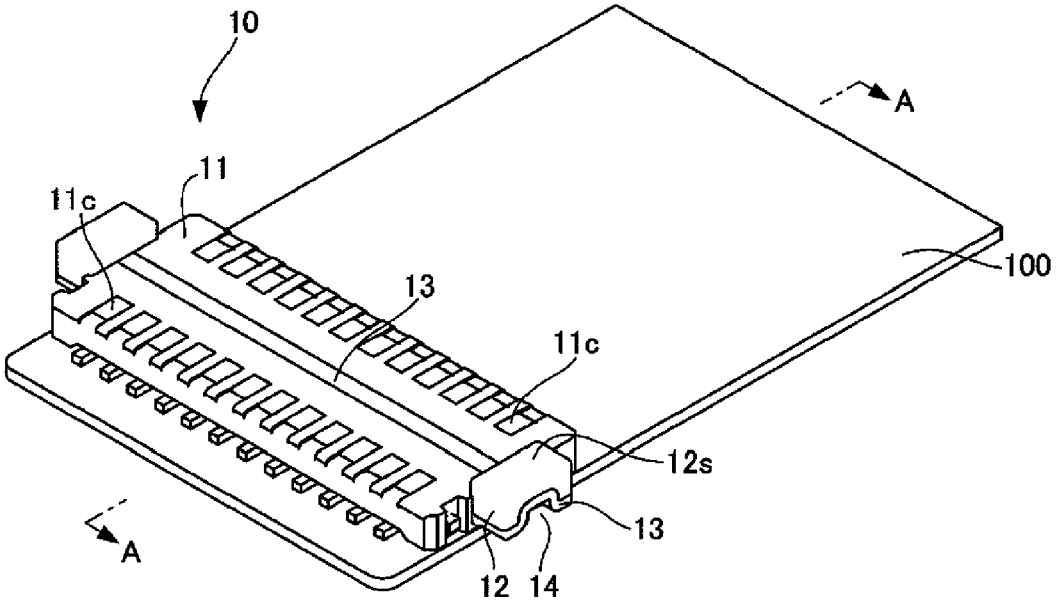


FIG. 2

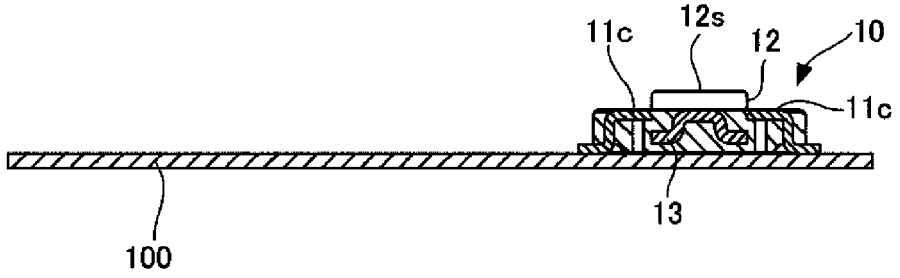


FIG. 3

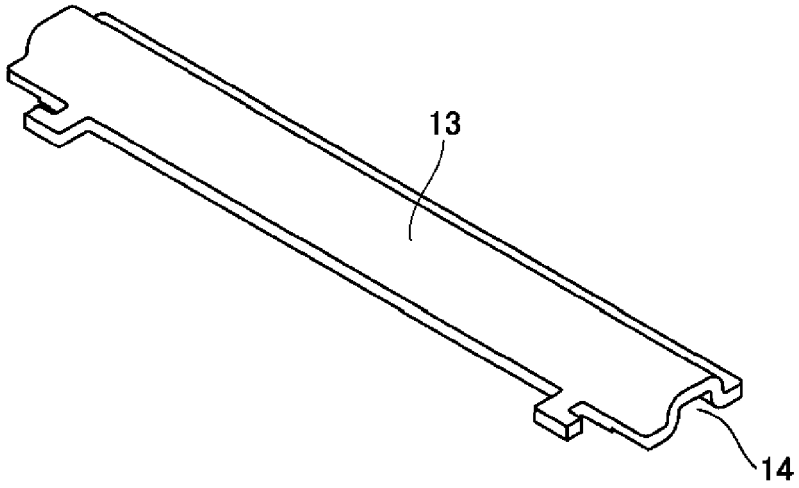


FIG. 4

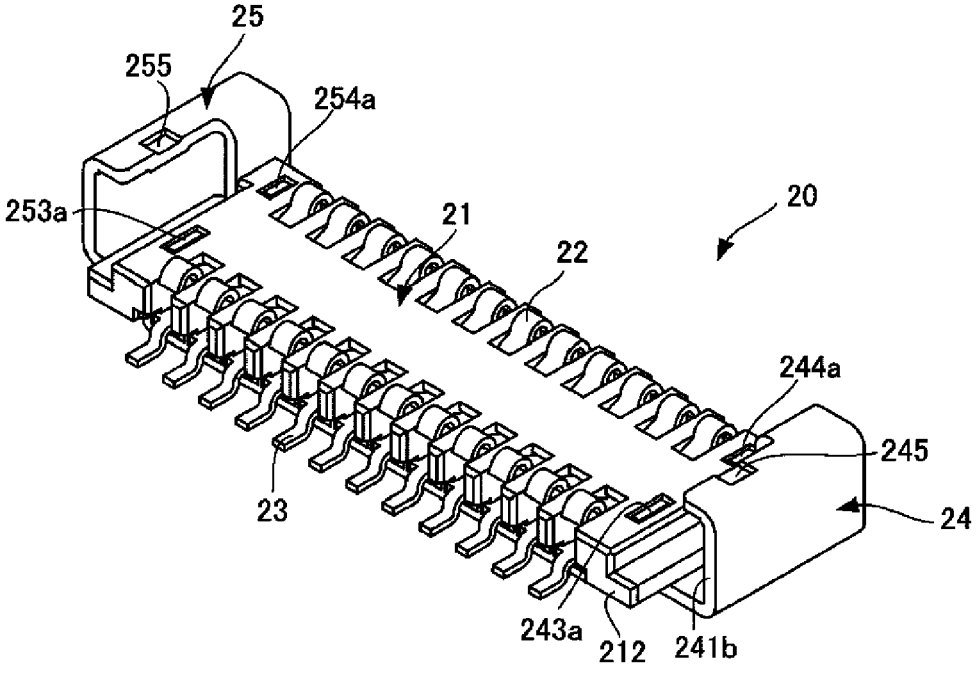


FIG. 5A

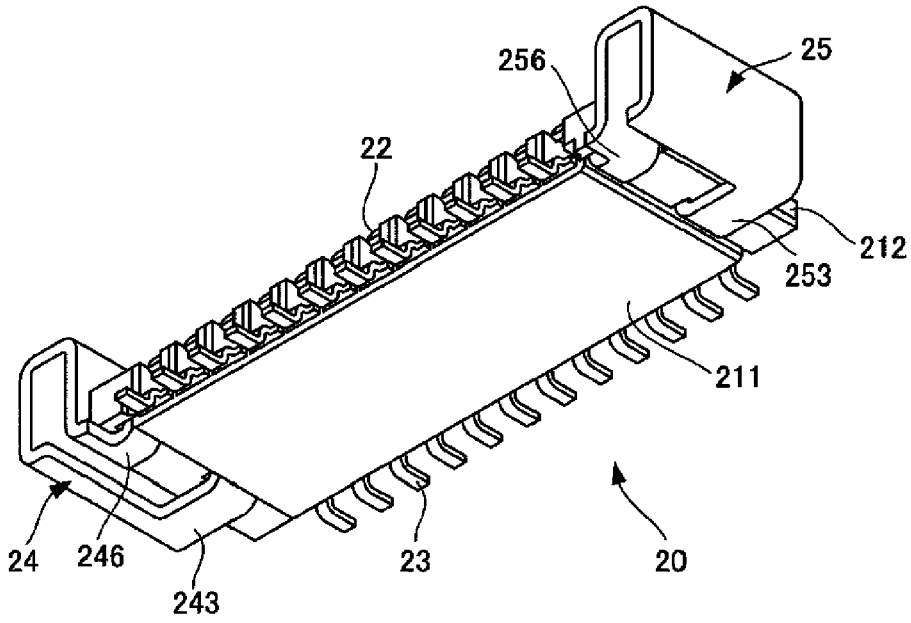
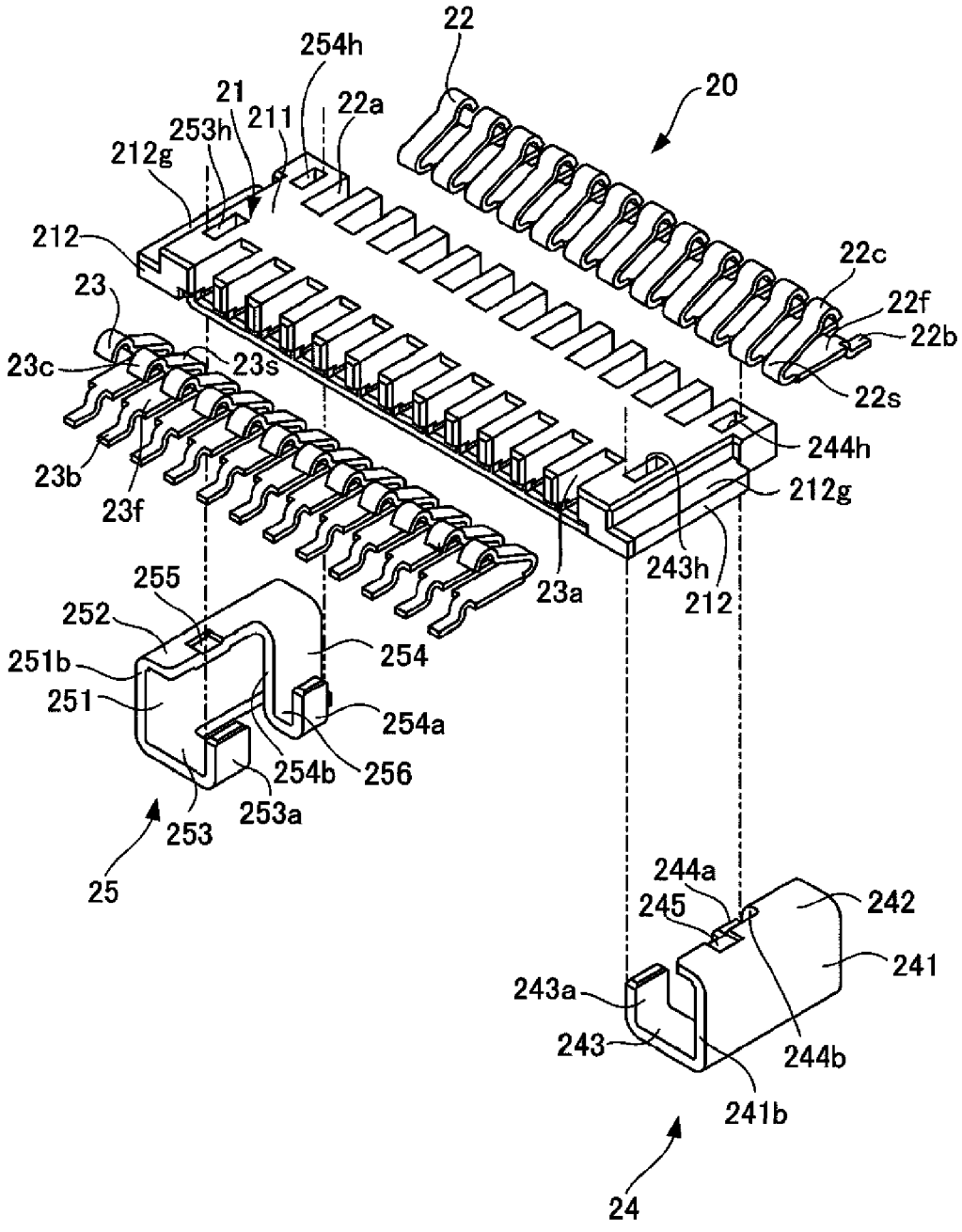


FIG. 5B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22c
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22b
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243h
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251b
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FIG. 6

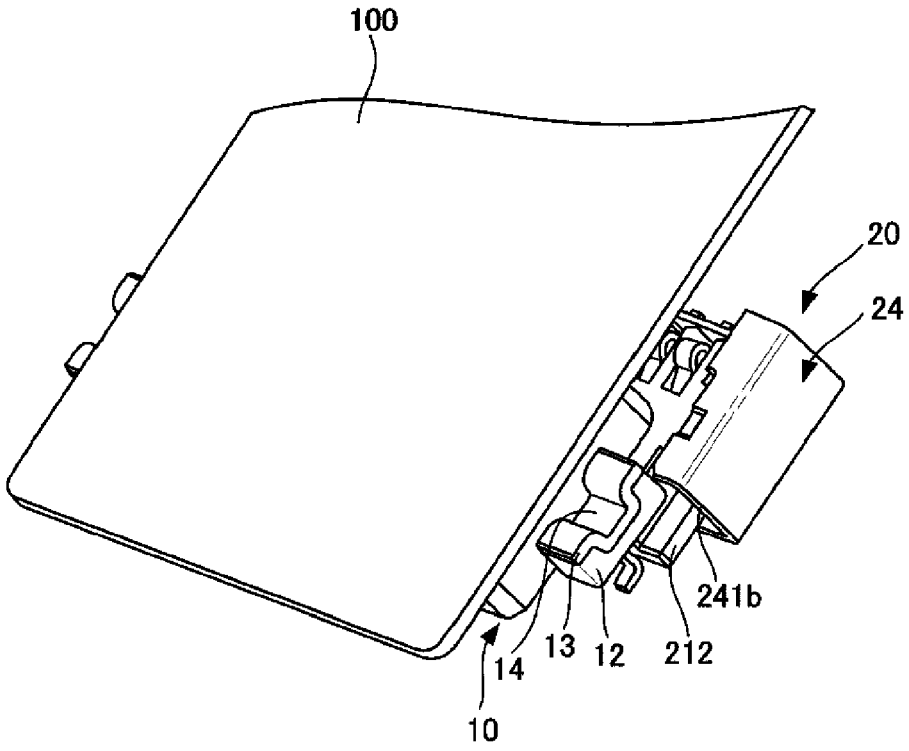

FIG. 7

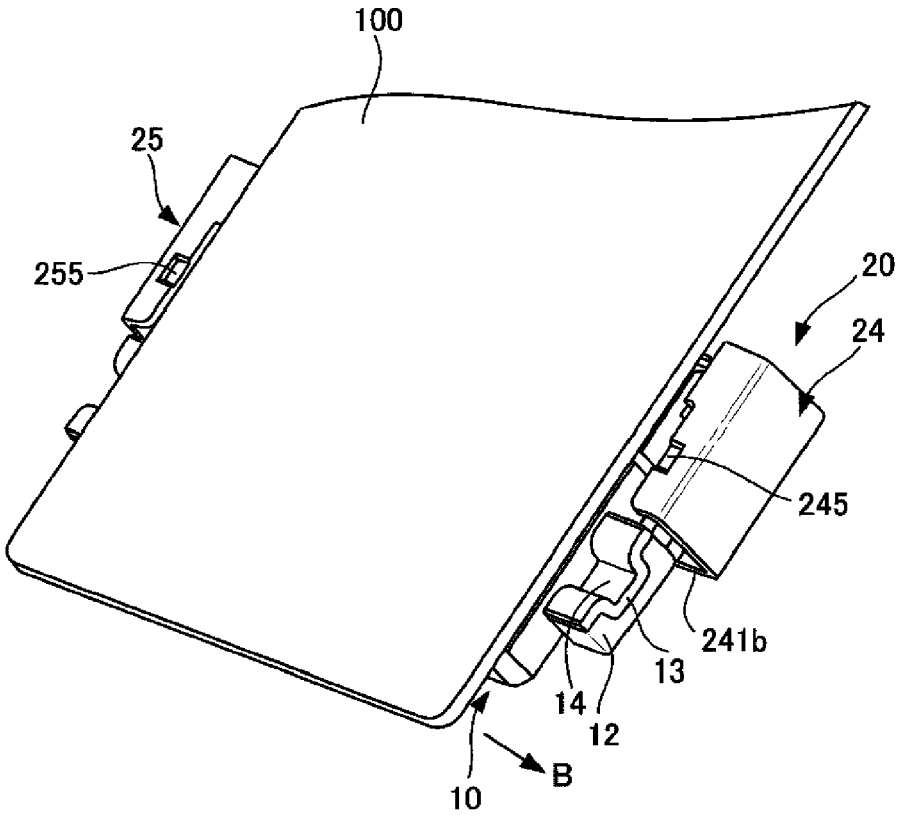

FIG. 8

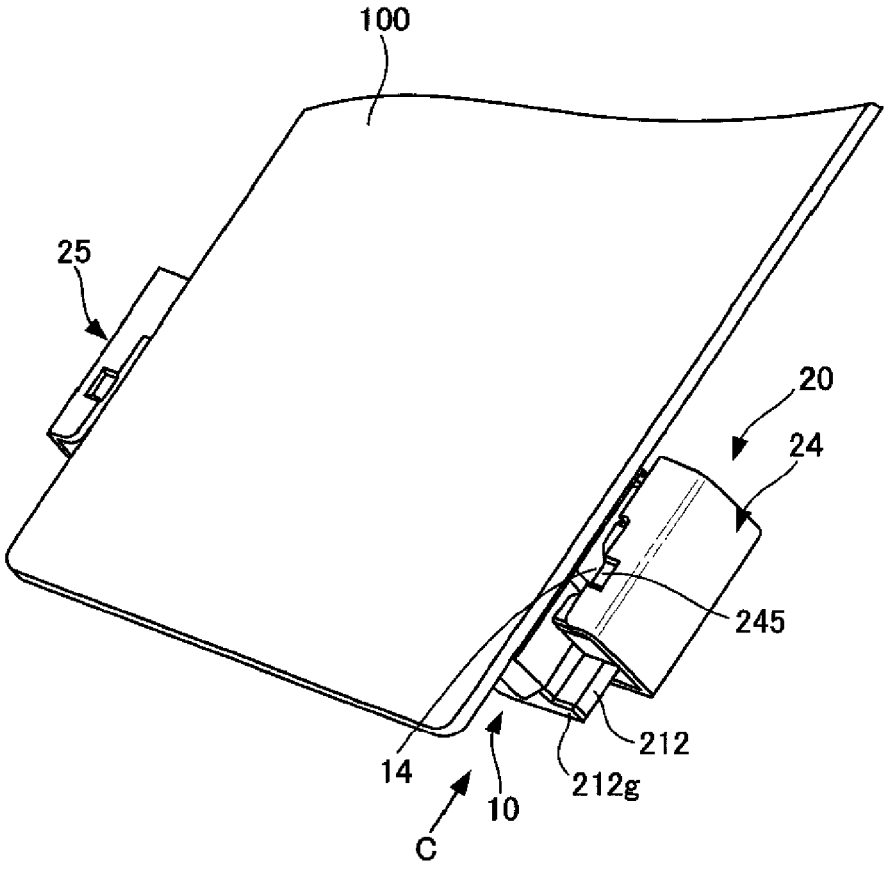

FIG. 9

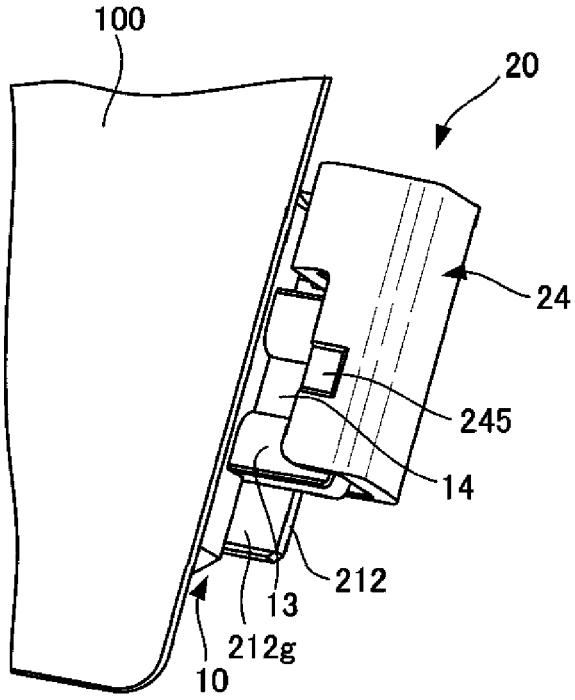

FIG. 10A

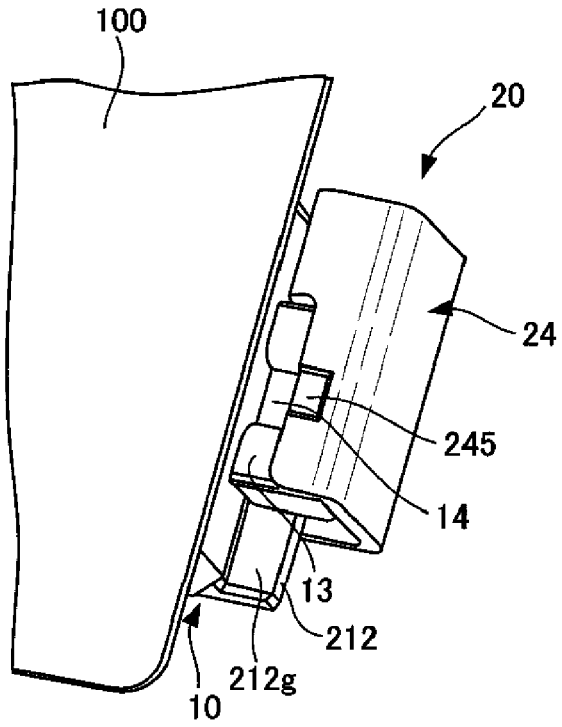

FIG. 10B

CONNECTOR

CROSS REFERENCE TO RELATED APPLICATION

The contents of the following Japanese patent application are incorporated herein by reference,

NO. 2013-129672 filed on Jun. 20, 2013.

FIELD

The present invention relates to a connector.

BACKGROUND

There is conventionally known a connector such that a plug and a socket are provided on two substrates, respectively, in order to electrically connect those substrates and the plug is inserted into the socket while bringing those substrates closer to each other to achieve electrical connection between printed wires on the two substrates (see Patent Literature 1, for example).

There is also known a connector to be fixed on a substrate and to which a plate cable is attached (see Patent Literature 2, for example). The connector of Patent Literature 2 includes a hollow housing having an upper surface portion, a first side portion, and a second side portion. The housing includes: an upper surface opening allowing the plate cable to pass therethrough; a first retaining part for interfering with an end face of a wing portion of a reinforcing plate in the plate cable moving toward the second side portion; and a second retaining part for interfering with the reinforcing plate moving toward the upper surface portion.

CITATION LIST

Patent Literature

Patent Literature 1: Japanese Patent Application Publication No: 2013-41771

Patent Literature 2: Japanese Patent Application Publication No: 2012-252864

SUMMARY

Technical Problem

What is needed in Patent Literature 1 is a reduction in the height of the connector. Patent Literature 2 also has problems such that: the connector cannot deal with connecting a large number of wires; accuracy of alignment therebetween when the plate cable is attached to the connector on the substrate cannot be improved; and the cost of the plate cable having the reinforcing plate cannot be reduced.

The present invention has been made in order to solve such problems. It is an object of the present invention to provide a connector capable of: being used for substrate-to-substrate connection, substrate-to-FPC connection, or the like; achieving a height reduction; dealing with connecting a large number of wires; improving alignment accuracy when electrically connecting a plug to a receptacle; and achieving a cost reduction.

Solution to Problem

A plug used for a connector according to the present invention includes: a housing of a plate shape having a width direction, a depth direction, and a thickness direction; contacts disposed on respective side surfaces of the housing in the depth direction so as to be parallel to each other in the width direction at regular intervals; a conductive reinforcing plate formed in an elongate plate shape and disposed in the width direction at a center of the housing in the depth direction; and locking parts provided at positions projected from opposite side surfaces of the housing in the width direction.

A receptacle used for the connector according to the present invention includes: a housing of a plate shape having a width direction, a depth direction, and a thickness direction; contacts disposed on respective side surfaces of the housing in the depth direction so as to be parallel to each other in the width direction at regular intervals, the number and positions of the contacts corresponding to those of the contacts of the above-described plug; and hold-down parts provided at positions projected from respective side surfaces of the housing in the width direction, each of the hold-down parts having an insertion opening and an internal space into which the locking part of the plug can be inserted in the depth direction, and a holding part for holding the locking part at a predetermined position, the insertion opening being in communication with the internal space in the depth direction of the housing.

The connector according to the present invention includes the above-described plug and the above-described receptacle.

According to the configuration of the present invention, a height reduction can be achieved; it is possible to deal with connecting a large number of wires; alignment accuracy when electrically connecting the plug to the receptacle can be improved; and a cost reduction can be achieved.

In the plug, the reinforcing plate may be conductive.

In the receptacle, the housing of the receptacle may include a guiding part at each of ends thereof in the width direction, and the guiding part may define part of the internal space of each of the hold-down parts.

In the receptacle, the housing of the receptacle may be provided with a reference surface used when starting an operation of fitting the plug into the receptacle, and the reference surface and the guiding part together may form the insertion opening.

In the connector, an engagement protrusion may be formed in the hold-down part of the receptacle; a recess into which the engagement protrusion is to be fitted may be formed in the locking part of the plug; the receptacle or the locking part may have elasticity; and the engagement protrusion may be fitted into the recess or the fitting may be released when the plug and the receptacle are moved relative to each other in the depth directions of the respective housings thereof.

In the connector, the locking part of the plug and the housing of the receptacle may be provided with reference surfaces, respectively; and when an operation of fitting the plug into the receptacle is started, the reference surfaces may be arranged so as to be parallel to and close to each other in order to achieve alignment between the plug and the receptacle for fitting.

Advantageous Effects of Invention

According to the present invention, it is possible to provide a connector capable of: being used for substrate-to-substrate connection, substrate-to-FPC connection, or the like; achieving a height reduction; dealing with connecting a large number of wires; improving alignment accuracy when electrically connecting a plug to a receptacle; and achieving a cost reduction.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1**A is a perspective view, as viewed from a plug assembled body side, illustrating a connector according to an

embodiment of the present invention in a state where a plug has been fitted into a receptacle, and FIG. **1**B is a perspective view illustrating the same as viewed from the receptacle side.

FIG. **2** is a perspective view illustrating the plug assembled body obtained by fixing the plug to an FPC according to the embodiment of the present invention.

FIG. **3** is a cross-sectional view taken along line A-A of FIG. **2** as viewed in a direction indicated by an arrow.

FIG. **4** is a perspective view illustrating an example of a reinforcing plate provided to the plug according to the embodiment of the present invention.

FIG. **5**A is a perspective view illustrating the receptacle as viewed from a side where the plug assembled body according to the embodiment of the present invention is to be attached, and FIG. **5**B is a perspective view illustrating the same as viewed from a direction different from that of FIG. **5**A.

FIG. **6** is an exploded perspective view illustrating the receptacle of FIG. **5**A as viewed from the side where the plug assembled body according to the embodiment of the present invention is to be attached.

FIG. **7** is a partial enlarged perspective view used for explaining a procedure for fitting the plug into the receptacle according to the embodiment of the present invention, illustrating a state when alignment between the plug and the receptacle is being performed.

FIG. **8** is a partial enlarged perspective view used for explaining a procedure for fitting the plug into the receptacle according to the embodiment of the present invention, illustrating a state when the plug is being pushed against the receptacle.

FIG. **9** is a partial enlarged perspective view used for explaining a procedure for fitting the plug into the receptacle according to the embodiment of the present invention, illustrating a state when the plug has been slid over the receptacle to complete the fitting therebetween.

FIG. **10**A is a partial enlarged perspective view used for explaining a procedure for checking a fitting state between the plug and the receptacle according to the embodiment of the present invention, illustrating an imperfect fitting state, and FIG. **10**B is a partial enlarged perspective view used for explaining the procedure for checking a fitting state between the plug and the receptacle according to the embodiment of the present invention, showing a normal fitting state.

DESCRIPTION OF EMBODIMENTS

A connector according to an embodiment of the present invention will now be described below with reference to the drawings.

FIGS. **1**A and **1**B are each a perspective view illustrating a connector **1** according to the embodiment of the present invention in which a plug **10** has been fitted into a receptacle **20**.

Contacts **11***c* of the plug **10** are soldered to contacts (not shown) of an FPC (flexible printed circuit) **100** to form a plug assembled body.

The FPC **100** is a board obtained by forming a circuit on a substrate including an insulating thin and flexible base film such as a polyimide film and a conductive metal such as a copper foil adhered to each other. Since a reinforcing plate **13** is provided to the plug **10** as will be described later, it is optional whether to provide a reinforcing plate to the FPC **100**.

As will be described later, fitting between the plug **10** and the receptacle **20** is performed by inserting locking parts **12** provided at opposite ends of the reinforcing plate **13** in the plug **10** into spaces inside hold-down parts **24** and **25** of the receptacle **20** and engaging engagement protrusions **245** and **255** of the hold-down parts **24** and **25** with respective recesses **14** in the locking parts **12**. The recesses **14** and the engagement protrusions **245** and **255** together form holding parts.

FIGS. **2** and **3** each illustrate the plug assembled body when the fitting between the plug **10** and the receptacle **20** is released.

The plug **10** includes: a housing **11**; the plurality of contacts **11***c* embedded in the housing **11**; and the reinforcing plate **13**.

The housing **11** is made of a synthetic resin molded in a plate shape and has a depth direction thereof in a longitudinal direction of the FPC **100**, a width direction thereof in a width direction of the FPC **100**, and a thickness direction thereof in the same direction as a thickness direction of the FPC **100**.

The plurality of contacts **11***c* are provided on respective side surfaces of the housing **11** in the depth direction so as to be parallel to each other in the width direction at regular intervals. Each of the contacts **11***c* has: a contact portion exposed from the housing on a visible side in FIG. **2**; and a contact portion exposed on the FPC **100** side and soldered to the conductive metal in the FPC **100**. The contact portions exposed on the visible side in FIG. **2** come into contact with corresponding contact portions of contacts **22** and **23** in the receptacle **20**.

The reinforcing plate **13** is embedded in the width direction at a center of the housing **11** in the depth direction, i.e., between the rows of the contacts **11***c* provided on both the side surfaces thereof. The reinforcing plate **13** is formed from a stainless steel plate in an elongate plate shape, for example.

As illustrated in FIG. **4**, the reinforcing plate **13** is formed to have a protrusion projecting toward the front side thereof in the width direction in order to enhance the strength thereof. The recess **14** formed by a space along the protrusion is provided on the rear surface side of the reinforcing plate **13**.

The shape of the reinforcing plate **13** is not limited to such a shape having a protrusion. As long as a predetermined strength can be obtained, a shape such that a cross-section in the short direction has an L-shape or I-shape may be employed, for example.

Also, the reinforcing plate **13** has a conductive property. Therefore, by functioning as a ground plate, the reinforcing plate **13** can serve to prevent communication failure such as crosstalk when assembled as the connector **1**.

As illustrated in FIG. **2**, the opposite ends of the reinforcing plate **13** in the longitudinal direction are projected from the opposite ends of the housing **11** in the width direction. The locking parts **12**, each having a rectangular shape and made of the synthetic resin same as the material of the housing **11**, are provided at the projected portions. Thus, when the plug **10** is fixed to the FPC **100**, the locking parts **12** are disposed at positions projected from the opposite ends of the FPC **100** in the width direction as illustrated in FIG. **2**.

The locking parts **12** can be integrally molded when the housing **11** is formed. Further, the locking parts **12** are formed in a size capable of being inserted into the spaces inside the hold-down parts **24** and **25** of the receptacle **20**.

As illustrated in FIG. **3**, the locking part **12** includes: a slide surface **12***s* positioned above a surface of the contact **11***c* at which the contact portion to be in contact with the contact portion of the receptacle **20** (i.e., the contact portion on the upper side in FIG. **3**) is exposed; and side surfaces extending toward the FPC **100** from the opposite edges of the slide surface **12***s*. As will be described later, the slide surface **12***s* slides over a guiding surface **212***g* of a guiding part **212** in the receptacle **20**. One of the side surfaces of the locking part **12**

serves as a reference surface used for positioning when the plug **10** is fitted into the receptacle **20**.

FIGS. **5**A and **5**B are perspective views illustrating the receptacle **20** as viewed from directions different from each other. FIG. **6** is an exploded perspective view of the receptacle **20**. With reference to these figures, a configuration of the receptacle **20** will be described in detail.

The receptacle **20** includes: a housing **21**; the contacts **22** and **23**; and the hold-down parts **24** and **25**.

The housing **21** is in the form of a frame made of a synthetic resin such as an LCP (Liquid Crystal Polymer). The housing **21** is formed in a plate shape having a width direction, a depth direction, and a thickness direction. The housing **21** includes: a contact attachment part **211**; and the guiding parts **212** for guiding the locking parts **12** of the plug **10** when the contacts are fitted.

The width direction, the depth direction, and the thickness direction of the housing **21** of the receptacle **20** coincide with those of the housing **11** of the plug **10**, respectively, when the plug **10** is fitted into the receptacle **20**.

The contact attachment part **211** includes a plurality of grooves **22***a* formed on the respective side surfaces thereof in the depth direction so as to be parallel to each other in the width direction at regular intervals. A single contact **22** or **23** is attached to each of the grooves **22***a*. The number and positions of the contacts **22** and **23** correspond to those of the contacts **11***c* in the plug **10**.

The contacts **22** and **23** comprise: curved contact portions **22***c* and **23***c* to be in contact with the contact portions of the contacts **11***c* in the plug **10**; contact portions **22***b* and **23***b* to be connected to contacts of a substrate (not shown); fixed portions **22***f* and **23***f* to be fixed in the grooves **22***a* of the contact attachment part **211**; and elastic deformable portions **22***s* and **23***s* positioned between the fixed portions and the curved contact portions, respectively.

Through holes **243***h*, **244***h*, **253***h*, and **254***h* used for the attachment of the hold-down parts **24** and **25** are formed at the opposite ends of the contact attachment part **211** in the width direction and in the vicinity of the guiding parts **212**. Attachment portions **243***a*, **244***a*, **253***a*, and **254***a* of the hold-down parts **24** and **25** are inserted into and fixed to these through holes.

The hold-down parts **24** and **25** have a mirror-image relationship when they face each other, i.e., have a symmetrical shape about a plane provided therebetween.

The hold-down parts **24** and **25** each are made of a copper alloy material, for example, and formed in a shape of a hollow generally rectangular column. More specifically, the hold-down parts **24** and **25** include: main body walls **241** and **251** disposed in a direction perpendicular to the plane of the contact attachment part **211**; and pushed walls **242** and **252** extending from upper ends (as viewed in FIG. **6**) of the main body walls **241** and **251** in directions facing each other so as to be parallel to the plane of the contact attachment part **211**, respectively.

Furthermore, fixed walls **243** and **253** extend from lower ends (as viewed in FIG. **6**) of the main body walls **241** and **251** in directions facing each other so as to be parallel to the plane of the contact attachment part **211**, respectively. Also, leg portions **243***a* and **253***a* extend upwardly from ends of the fixed walls **243** and **253**, respectively.

Also, stopping walls **244** and **254** extend downwardly from opposing end faces of the pushed walls **242** and **252** so as to be parallel to the main body walls **241** and **251**, respectively. Fixed walls **246** and **256** extend from lower ends of the stopping walls **244** and **254**, respectively, in directions facing each other so as to be parallel to the plane of the contact attachment part **211**. Leg portions **244***a* and **254***a* extend upwardly from ends of the fixed walls **246** and **256**, respectively.

The leg portions **243***a* and **244***a* of the hold-down part **24** are inserted into and fixed to the through holes **243***h* and **244***h* of the contact attachment part **211**, respectively. Also, the leg portions **253***a* and **254***a* of the hold-down part **25** are inserted into and fixed to the through holes **253***h* and **254***h* of the contact attachment part **211**, respectively.

The engagement protrusions **245** and **255**, projecting toward the side of the fixed walls **246** and **256**, are formed on the pushed walls **242** and **252**. The engagement protrusions **245** and **255** can be formed by press work, for example. The pushed walls **242** and **252** can be deformed and has elasticity. Therefore, the engagement protrusions **245** and **255** can return to their original positions after a force lifting the engagement protrusions **245** and **255** outwardly is applied thereto and then removed therefrom.

Internal spaces of the hold-down parts **24** and **25** are defined by the confining walls, such as **241**, **242**, and **243**, forming the hold-down parts **24** and **25** and the guiding surfaces **212***g* of the guiding parts **212**, respectively.

When fitting the plug **10** into the receptacle **20**, the engagement protrusions **245** and **255** each can climb over a portion of the reinforcing plate **13** in the locking part **12** and fit into the recess **14**. This allows the plug **10** to be fitted into the receptacle **20** in the right position.

Continuous end faces of the pushed walls **242** and **252**, the main body walls **241** and **251**, the fixed walls **243** and **253**, and the leg portions **243***a* and **253***a* form reference surfaces **241***b* and **251***b* used for aligning the plug **10** with the receptacle **20** upon the fitting therebetween, respectively.

The reference surfaces **241***b* and **251***b* and the guiding parts **212** together form insertion openings through which the locking parts **12** of the plug **10** are to be inserted. The insertion openings are in communication with the internal spaces of the hold-down parts **24** and **25** in the depth direction of the housing **21**.

End faces of the stopping walls **244** and **254** on the side of the insertion openings form stopping parts **244***b* and **254***b*, respectively. When the plug **10** is fitted into the receptacle **20**, these stopping parts serve to stop the locking parts **12** of the plug **10** at predetermined positions so that the locking parts **12** do not move beyond the proper fitting positions.

In FIG. **5**A, the lower surfaces of the fixed walls **243**, **253**, **246**, and **256** in the hold-down parts **24** and **25** are fixed to the substrate (not shown) by means of reflow soldering or the like. As a result, the receptacle **20** is fixed to the substrate.

Procedures when the plug **10** and the receptacle **20** are slid over each other for fitting therebetween in the depth directions of the respective housings thereof according to the embodiment of the present invention will now be described with reference to FIGS. **7** to **9**. Although only one locking part **12** in the plug **10** and only one hold-down part **24** in the receptacle **20** positioned on one side are shown in these figures, the same procedures as those shown in these figures are applied also to the other locking part **12** in the plug **10** and the hold-down part **25** in the receptacle **20** positioned on the other side.

First of all, the width direction of the plug **10** in the plug assembled body is generally aligned with that of the receptacle **20**. Then, the plug **10** in the plug assembled body is faced to and moved toward the receptacle **20**, and they are held so as to be slightly displaced from each other and to be parallel to each other. As illustrated in FIG. **7**, as the plug **10** is brought closer to the receptacle **20**, they are disposed in such a manner that one side surfaces (the right side surface in FIG. **7**) of the

locking parts **12** of the plug **10** are positioned parallel to and close to the reference surfaces **241***b* and **251***b* of the hold-down parts **24** and **25** in the receptacle **20**, respectively. It is thereby possible to reliably perform positioning between the locking parts **12** of the plug **10** and the hold-down parts **24** and **25** of the receptacle **20** upon fitting.

According to the state shown in FIG. **7**, the plane of the plug **10** and that of the receptacle **20** are faced each other and the curved contact portions **22***c* and **23***c* of the contacts **22** and **23** in the receptacle **20** are in contact with the flat surface of the plug **10** facing the receptacle **20**. However, the curved contact portions **22***c* and **23***c* of the contacts **22** and **23** are not in contact with the contacts **11***c* of the plug **10** in a proper manner.

Next, the FPC **100** in the plug assembled body is pushed toward the receptacle **20** as indicated by an arrow B in FIG. **8**. The curved contact portions **22***c* and **23***c* of the contacts **22** and **23** in the receptacle **20** are thereby pressed toward the grooves **22***a* by the flat surface of the plug **10** facing the receptacle **20**. The elastic deformable portions **22***s* and **23***s* of the contacts **22** and **23** in the receptacle **20** are thereby deformed, resulting in a configuration such that the locking parts **12** are faced to the insertion openings of the hold-down parts **24** and **25** as illustrated in FIG. **8**. In this state, the slide surfaces **12***s* of the locking parts **12** in the plug **10** are on the guiding surfaces **212***g* of the guiding parts **212** in the receptacle **20**.

Next, while pressing the plug assembled body against the receptacle **20**, the slide surfaces **12***s* of the locking parts **12** are slid over the guiding surfaces **212***g* of the guiding parts **212** in the receptacle **20** as indicated by an arrow C in FIG. **9** so as to insert the locking parts **12** into the internal spaces of the hold-down parts **24** and **25** through the insertion openings thereof. The inner face (the face perpendicular to the width direction of the housing **11**) of the locking part **12** is then being guided by the inner face (the face perpendicular to the width direction of the housing **21**) of the guiding part **212** in the receptacle **20**.

When the locking parts **12** are inserted into the respective internal spaces of the hold-down parts **24** and **25** through the insertion openings thereof, on the other hand, the engagement protrusions **245** and **255** in the pushed walls **242** and **252** of the hold-down parts **24** and **25** each abut against a side end of the reinforcing plate **13** in the short direction in the locking part **12**.

When the locking parts **12** are further pressed into the internal spaces of the hold-down parts **24** and **25**, the engagement protrusions **245** and **255** each ride on the side end of the reinforcing plate **13** in the short direction in the locking part **12** and further proceed to be fitted into the recess **14**.

This allows the engagement protrusions **245** and **255** to return to their original positions. This is because the pushed walls **242** and **252** at which the engagement protrusions **245** and **255** are formed can be deformed and has elasticity.

In order to release the fitting between the plug **10** and the receptacle **20**, the plug assembled body is slid relative to the receptacle **20** in a direction along the plane of the FPC **100** so as to pull out the locking parts **12** from the insides of the hold-down parts **24** and **25**.

Each of the engagement protrusions **245** and **255** is then being pushed up outwardly as it moves along a curved surface of the reinforcing plate **13** from the recess **14**. Each of the engagement protrusions **245** and **255** eventually climbs over the end of the reinforcing plate **13**, thereby being removed from the locking part **12**. Due to the elasticity of the pushed walls **242** and **252**, the engagement protrusions **245** and **255** return to their original positions. At this point, fitting between the plug **10** and the receptacle **20** is substantially released.

A procedure for checking if fitting between the plug **10** and the receptacle **20** is appropriate or not will now be described below with reference to FIGS. **10**A and **10**B.

In FIG. **10**A, one can visually confirm that the position of the engagement protrusion **245** in the hold-down part **24** of the receptacle **20** is displaced from that of the recess **14** in the locking part **12** of the plug **10**. This indicates that the engagement protrusion **245** has not been appropriately fitted into the recess **14**, thereby failing to return to its original position. Thus, the fitting has not been completed yet in such a state.

In FIG. **10**B, one can visually confirm that the engagement protrusion **245** in the hold-down part **24** of the receptacle **20** has been completely fitted into the recess **14** in the locking part **12** of the plug **10**. This is a state indicating that the engagement protrusion **245** has been appropriately fitted into the recess **14** and has returned to its original position. Such a state represents normal fitting.

According to the embodiment described above, the engagement protrusions **245** and **255** are provided in the respective hold-down parts **24** and **25** of the receptacle **20**; the recesses **14** are formed in the locking parts **12** of the plug **10**; and the engagement protrusions **245** and **255** are configured to be fitted into the recesses **14**. Instead, engagement protrusions may be formed in the locking parts **12** and recesses into which the engagement protrusions of the locking parts **12** are to be fitted may be formed in the pushed walls **242** and **252** of the hold-down parts **24** and **25**, for example. In this case, the locking parts **12** may have elasticity allowing the engagement protrusions to protrude or recede. Alternatively, portions of the pushed walls **242** and **252** may have a property capable of being elastically deformed and recesses into which engagement protrusions can be fitted may be formed in those portions.

Moreover, according to the embodiment described above, fitting between the plug **10** and the receptacle **20** can be checked by the engagement protrusions **245** and **255** in the hold-down parts **24** and **25** of the receptacle **20** being fitted into the recesses **14** in the locking parts **12** of the plug **10**. Instead, without forming the engagement protrusions **245** and **255** in the hold-down parts **24** and **25** and without forming the recesses **14** in the locking parts **12**, it is also possible to conclude that fitting has been completed when the side surfaces of the locking parts **12** serving as the reference surfaces abut against the stopping parts **244***b* and **254***b* formed on the end faces of the stopping walls **244** and **254** in the hold-down parts **24** and **25** on the side of the insertion openings. In this case, the stopping parts **244***b* and **254***b* function as holding parts.

In such a configuration, the surface of the locking part **12** of the plug **10** at which the reinforcing plate **13** is provided is pressed against the inner surface of each of the pushed walls **242** and **252** of the hold-down parts **24** and **25** due to the elastic force of the contacts **22** and **23** in the receptacle **20**. Due to the frictional force generated at that position, fitting between the plug **10** and receptacle **20** cannot be easily released even without the engagement between the engagement protrusion and the recess.

Note that the technical scope of the connector according to the present invention is not limited to the embodiments described above. It includes various variations and modifications without departing from the scope of the present invention.

REFERENCE SIGNS LIST

1 Connector
10 Plug

11, **21** Housing
11*c*, **22**, **23** Contact
12 Locking part
12*s* Slide surface
13 Reinforcing plate
14 Recess
20 Receptacle
24, **25** Hold-down part
100 FPC
212 Guiding part
212*g* Guiding surface
242 Pushing wall
245 Engagement protrusion

The invention claimed is:

1. A receptacle comprising:
a housing of a plate shape having a width direction, a depth direction, and a thickness direction;
contacts disposed on respective side surfaces of the housing in the depth direction so as to be parallel to each other in the width direction, the number and positions of the contacts corresponding to those of the contacts of a plug including a locking part; and
hold-down parts provided at positions projected from respective side surfaces of the housing in the width direction, each of the hold-down parts having an insertion opening and an internal space into which the locking part of the plug can be inserted in the depth direction, and a holding part for holding the locking part at a predetermined position, the insertion opening being in communication with the internal space in the depth direction of the housing.

2. The receptacle according to claim **1**, wherein the plug comprises:
a housing of a plate shape having a width direction, a depth direction, and a thickness direction;
contacts disposed on respective side surfaces of the housing in the depth direction so as to be parallel to each other in the width direction, the number and positions of the contacts corresponding to those of the contacts of the receptacle;
a reinforcing plate formed in an elongate plate shape and disposed in the width direction at a center of the housing in the depth direction; and
locking parts, including the locking part, provided at positions projected from opposite side surfaces of the housing in the width direction.

3. The receptacle according to claim **1**, wherein the housing of the receptacle includes a guiding part at each of ends thereof in the width direction, and the guiding part defines part of the internal space of each of the hold-down parts.

4. The receptacle according to claim **3**, wherein the housing of the receptacle is provided with a reference surface used when starting an operation of fitting the plug into the receptacle, and the reference surface and the guiding part together form the insertion opening.

5. A connector comprising:
a plug comprising:
a housing of a plate shape having a width direction, a depth direction, and a thickness direction;
contacts disposed on respective side surfaces of the housing in the depth direction so as to be parallel to each other in the width direction;
a reinforcing plate formed in an elongate plate shape and disposed in the width direction at a center of the housing in the depth direction; and
locking parts provided at positions projected from opposite side surfaces of the housing in the width direction; and
a receptacle comprising:
a housing of a plate shape having a width direction, a depth direction, and a thickness direction;
contacts disposed on respective side surfaces of the housing in the depth direction so as to be parallel to each other in the width direction, the number and positions of the contacts corresponding to those of the contacts of the plug; and
hold-down parts provided at positions projected from respective side surfaces of the housing in the width direction, each of the hold-down parts having an insertion opening and an internal space into which the locking part of the plug can be inserted in the depth direction, and a holding part for holding the locking part at a predetermined position, the insertion opening being in communication with the internal space in the depth direction of the housing.

6. The connector according to claim **5**, wherein the reinforcing plate is conductive.

7. The connector according to claim **5**, wherein: an engagement protrusion is formed in the hold-down part of the receptacle; a recess into which the engagement protrusion is to be fitted is formed in the locking part of the plug; any of the receptacle and the locking part has elasticity; and the engagement protrusion can be fitted into the recess and the fitting can be released when the plug and the receptacle are moved relative to each other in the depth directions of the respective housings thereof.

8. The connector according to claim **5**, wherein: the locking part of the plug and the housing of the receptacle are provided with reference surfaces, respectively; and when an operation of fitting the plug into the receptacle is started, the reference surfaces are arranged so as to be parallel to and close to each other in order to achieve alignment between the plug and the receptacle for fitting.

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